Get a Grip: Do Leg exercises Increase Arm strength?

by Michael Hyland, PT, DPT, CEEAA

Editor's Note: This clinical case commentary was part of content for the March 2021 Journal Club. These case studies are intended to demystify the more formal statistics and format of a peer-reviewed article and translate key concepts into clinically usable information. Join us for Journal Club on the third Tuesdays of January, March, May, July, September and November at 8 pm ET to discuss current concepts with a wide range of peers. Register to join us or view archived recordings at geriatricspt.org/journal-geriatric-physical-therapy.

Falls are associated with high morbidity and mortality in the aging population. There are multiple risk factors associated with falls. Risk reduction strategies such as exercise have shown to be successful as a single or as part of a multifactorial intervention in community-dwelling populations for fall reduction.[1]

Previously published studies in falls prevention have demonstrated that The Otago Exercise Program (OEP) is an exercise program that can be implemented to improve lower limb weakness and balance. But is it an appropriate strategy to use for improving upper body strength as well? This Journal Club article raises a novel concept: that grip strength (and by inference upper extremity strength) is also improved or at least maintained by the 17 primarily lower extremity exercises of the OEP.

Subjective Examination

Karen is a 69 y/o female who self-referred to a home-based outpatient physical therapy agency when she recognized increasing job anxiety due to fear of falls. She reported falling 6-7 times in the last 2 years, sometimes with injuries. She reported occasional right knee buckling with loss of balance and difficulty with stairs. Personal trainer sessions at a local gym had been helpful for her but balance issues still resulted in much fear, especially when carrying objects while going up and down stairs. Frequent stair climbing while carrying a laptop, supply bag, and often other equipment was a necessary job requirement in her position as a home care nurse.

Past Medical History: GERD, depression, obesity, OA, breast cancer, lumpectomy in 2010, and R TKA in 2018. At the time of treatment, she was taking 4 prescription medications and a magnesium supplement.

Home environment and functional status: Karen resides alone in a ground level apartment and works 2 days per week as an RN in home care. She is sedentary when not working despite biweekly workouts with the personal trainer. Divorced with 2 grown children, one lives nearby. Other than occasional outings for coffee or lunch with friends she reports infrequent social activity. She is able to drive independently. Prior to therapy she would become short of breath with long distances of walking (more than a block). She stated that the step up into her apartment from garage had been such an issue that she had a bar installed so that she could hold on when coming in and out of the apartment. She avoided stairs unless she had no choice as her reported falls were associated with going up steps at patient homes.

Patient goals: Karen expressed her biggest goals were to stop falling and to walk in the community with more confidence.

Objective Examination at Initial Evaluation

Vital signs at Rest: BP 116/88 mmHg, HR 104 bpm, Temp 98.4 degrees F, RR 18 breaths/min

Lower body strength: 30 Second Chair Stand Test (30SCST) 10 reps

Functional Mobility: TUG 14 seconds. TUG with carrying object 20 seconds. Tested ablity to perform SLS to place foot on step stool and patient unable without at least one hand support.

Gait Speed: 2.36 feet/sec using 8-foot gait velocity test

Posture: Karen presented with moderate thoracic hyper-kyphosis and moderate left knee genu valgus

Balance: Four stage balance test results: able to hold feet together x10 seconds, instep position x10 seconds, tandem stance x10 seconds, and SLS of 3 seconds with LOB.

Sensory Integration of Balance: mCTSIB score was 98/120 with LOB on condition 4 and noted sway of trunk.

Assessment: Karen demonstrated impaired vestibular balance, slow walking speed, and inability to perform SLS resulting in fall risk. In addition, 30SCST of 10 repetitions indicates fall risk for a woman of her age and inadequate lower body strength to prevent falls. She has had multiple falls, some with injury, and is at high risk for falling again, despite working out with a trainer regularly. She is in need of physical therapist expertise in order to address specific causes of falling and will benefit from skilled PT plan of care.

Plan: Karen will receive outpatient therapy in her home including to implement Otago balance program 2 times per week for 5 weeks or total of ten visits to address impairments and to reach her personal goal(s) of no falls and more confidence to walk in the community.

Treatment Methods

The treatment regimen included the seated and standing strengthening exercises and balance exercises chosen for Karen as described in the Otago program manual. Warm up exercises were only completed on first treatment session. She completed seated strengthening exercises and standing strengthening exercises, as well as majority of the balance exercises found in the program on each visit. The seated exercises consisted of long-arc quad sets without and then with resistance that progressed over time. Sit-to-stand was a regular exercise in the POC. Standing exercises consisted of heel raises, toe raises, hamstring curls, hip abduction, and mini squats with resistance added over time. Balance exercises conducted consistently were tandem walking, backwards walking, sideways walking, toe walking, heel walking, tandem stance, and single leg stance. In addition, Karen was also trained on foam balance pad to address likely vestibular system deficits. Other seated and standing marching exercises, with resistance, were added due to her inability to lift lower extremities high enough to clear steps/stair risers. Table 1 shows the interventions from the OEP performed at first treatment session, exercises performed at tenth session, and then at discharge. Note the differences and the way these were progressed over time.

Results at D/C

Vital signs at Rest: BP 119/84 mmHg, HR 108 bpm, Temp 98.0 degrees F, RR 20 breaths/min

Lower body strength: 30 Second Chair Stand Test (30SCST) improved from 10 reps to 12 reps indicating improved lower body strength and reduced fall risk.

Functional Mobility: TUG reduced from 14 seconds to 12.6 seconds indicating reduction in fall risk. TUG while carrying object reduced from 20 seconds to 16 seconds. Pt able to place lower extremity on step stool without UE support, though still needing single hand support for stairs.

Gait Speed: Increase from 2.36 feet/sec to 2.64 feet/sec using 8-foot gait velocity test indicating improved confidence with gait and reduced fall risk, though still showing risk of falls in community vs home.

TABLE 1

	1st Treatment Session	**10th Treatment Session**	**Final Treatment session (18th visit after POC extension)**
Strengthening Exercises			
Long Arc Quad Sets	X	2 x20 reps with 2.5# weights	2x 20 reps with 3# weights
Hamstring Curls	10 reps hold support	20 reps hold support	20 reps NO support with 3# weights
Hip Abduction	10 reps hold support	20 reps hold support	20 reps NO support with 3# weights
Calf Raises	10 reps hold support	20 reps NO support	20 reps NO support with 3# weights
Toe Raises	10 reps hold support	20 reps hold support	
Balance Exercises			
Mini Squats	10 reps hold support	20 reps NO support	20 reps NO support
Backwards Walking	2x 10 steps hold support	Held due to HS cramps	2x 10 reps NO support
Heel Walking	2x 10 steps hold support	Held due to HS cramps	2x 10 reps NO support
Backward Walking	2x 10 steps hold support	Held due to HS cramps	2x 10 reps NO support
Tandem Walking	2x 10 steps hold support	Held due to HS cramps	2x 10 reps NO support
Single Leg Stance	2x 10 seconds hold support	Held due to HS cramps	8 seconds without UE support
Tandem Stance	2x 10 seconds NO support	Held due to HS cramps	X
Sit to Stand	2 x10 reps without UE support	1x 20 reps without UE support	1x 20 reps without UE support
Stairs	X	X	4 steps x5 reps with single UE support on handrail

Posture: Karen presented with moderate thoracic hyper-kyphosis and moderate genu valgus of left knee that remained unchanged after therapy.

Balance: Four stage balance test results: feet together hold x10 seconds, instep position x10 seconds, tandem stance x10 seconds, and SLS of 8 seconds. Increase from 3 to 8 seconds on SLS is significant, though not a full 10 seconds as hoped for.

Sensory Integration of Balance: mCTSIB score increased from 98/120 to 120/120 indicating that vestibular balance was improved over baseline.

Assessment/Discussion

Karen had made objective improvements in all areas after the initial 10 visits, but had also developed hamstring cramping that was an issue for tolerating sessions and seemed to happen more after waking up in the morning. A plan of care was approved for an additional 8 visits. Through the total of her therapy sessions she was able to make objective gains in lower body strength, both static and dynamic balance, sensory integration of balance, and in walking speed. She was also able to negotiate stairs with reciprocal pattern, rather than a step-to pattern, reportedly for the first time in decades. Though her gains were not quite as large as hoped for they were definite and resulted in tremendous subjective improvement of self-confidence. Note the improvement in TUG while carrying objects from 20 seconds to 16 seconds, indicating that she was more confident and had improved balance while carrying objects in the arms. As of this writing she has not had a single fall since completing her therapy plan of care and continues to work with her trainer twice a week to keep as fit as possible. According to the research of Dr. Tiffany Shubert et al, regarding implementation of Otago in the USA, scores on 30 second chair rise, Timed Up and Go, and Four Stage Balance Test significantly improved.[2] Karen's case highlights the truth of this research and demonstrates the viability of delivering the Otago Exercise Program in the home under outpatient therapy benefits. In addition, this also shows that the results can be long lasting even months after the program has ended.

Can upper body strength, particularly grip strength, be improved or at least maintained by use of the OEP? For Karen, use of the upper body was crucial for doing the OEP exercises as she needed some upper body support for balance. She gripped the counter with 1 or both hands while performing exercises in therapy. Stair climbing was also performed while gripping a hand rail. In this sense her grip strength may have maintained or improved as was suggested in the article by Liew, et al.[1] Even though the OEP does not target upper extremity strength, it is conceivable that strength gains in the hands/wrist may occur. Ironically, fear of falling may actually result in a strong supportive grip when performing balance and strengthening exercises, thereby resulting in grip strength gains. As seen in Karen's case, use of the upper body to carry an object while performing an objective balance test such as the TUG may give clues as to how much the patient depends on upper body use for security during functional tasks. It may be valuable to incorporate greater use of upper body assessment and strength measures as part of a fall prevention program. For example, use of hand grip dynamometry as a baseline measure pre and post OEP, use of TUG and then comparing to TUG with carrying objects, and even including measures such as timed stair climbing if applicable to patient situation. These outcomes would be valuable for virtually any patient for whom falls are a concern. As with many areas, more research would be needed to see if these additions made a significant difference in both upper extremity strength and fall reduction over time. Regardless, it would definitely be a wise addition to future assessments to focus on the whole person and to present a more complete picture of their functional balance.

References

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2. Shubert TE, Smith ML, Jiang L, Ory MG. Disseminating the Otago Exercise Program in the United States: Perceived and actual physical performance improvements from participants. ***J Appl Gerontol***. 2018;37(1):79-98. doi:10.1177/0733464816675422

Dr. Michael Hyland earned a Doctorate in Physical Therapy from The University of St. Augustine for Health Sciences in St. Augustine, FL in 2012. After graduation from the DPT program he moved to the Tulsa, OK metro area and practiced Physical Therapy in Acute Care, Outpatient, and Home Health settings. In 2018 he opened a private practice, Hyland Physical Therapy and Wellness, that serves the aging adults 65+ with Parkinson's Disease and also focuses on fall prevention, delivering care in clients homes through home-based outpatient therapy and also offering a physical space for therapy services when needed/desired. Dr. Hyland has several certifications, including Certified Exercise Expert for the Aging Adult, APTA Credentialed Clinical Instructor, LSVT BIG certification, and certified as a provider of the Otago Exercise Program. He and his wife Dr. Jule Hyland, AuD have four children; two girls and two boys.